



McDONALD INSTITUTE CONVERSATIONS

Fuel and Fire in the Ancient Roman World

Towards an integrated economic understanding

Edited by Robyn Veal & Victoria Leitch

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Preface

This book arises from a conference held at the British School at Rome, and the Finnish Institute in Rome, in March 2013, entitled *Fuel and Fire in the Ancient Roman World*. The conference represented the first real attempt to try to bridge the gap between ‘top-down’ generalized models about Roman energy consumption (itself, still a relatively new area of research), and research carried out by artefact and environmental specialists. In many ways it exceeded our expectations, although it probably raised more questions than it answered. As fuel is used in many different domestic and industrial contexts, the papers were very heterogeneous; some presenters came from a strong archaeobotanical background, which is a central area for fuel research, while others came from social, technical and economic spheres, opening up the discussion beyond archaeobotany. Some papers presented more ‘qualitative’ rather than ‘quantitative’ results but, as a new research area, this was inevitable and qualitative evaluation can provide the framework for approaching quantitative studies. Nevertheless, useful quantitative beginnings are proposed in a number of papers. Although focused on the Roman period, the research often extended beyond this chronological span, to help contextualize the results.

We gratefully acknowledge the support and assistance of the British School at Rome and the *Institutum Romanum Finlandiae* (Finnish Institute of Rome). In particular we thank Professor Katariina Mustakallio, then director of the *IRF*, for generously hosting the conference lunch on the final day. The financial support of the Oxford Roman Economy Project, through

Professor Andrew Wilson, and a significant private donation from Mr Jim Ball, former Commonwealth Forests Chairman (administered through the BSR Rickman Fund) allowed speakers’ travel, accommodation and subsistence costs to be covered, as well as a contribution towards publication costs. Professor Wilson and Mr Ball both provided much appreciated moral support and intellectual input, acting as our major discussants. The McDonald Institute for Archaeological Research, through its Conversations series, also helped fund publication. Professor Graeme Barker (McDonald Institute director to September 2014), Professor Cyprian Broodbank (current director), Dr James Barrett (current deputy director) and Dr Simon Stoddart (former acting deputy director) all provided advice and guidance over time. This was much appreciated. Dora Kemp provided initial advice on manuscript preparation, and after her untimely death, Ben Plumridge took over the practical side of production. Maria Rosaria Vairo, then a Masters student of the University of Lecce, and Dana Challinor, a doctoral student at the University of Oxford, provided significant voluntary support during the conference and we thank them both profusely. Robyn Veal would also like to acknowledge the long-term financial and intellectual support of the Department of Archaeology, University of Sydney, through much of her early work on fuel. This led to the opportunity of a fellowship at the BSR, and the idea for this conference. The feedback from reviewers has greatly improved the book.

Robyn Veal & Victoria Leitch

Epilogue

Final discussions

Robyn Veal & Jim Ball

Introduction Robyn Veal

The conference was greatly enhanced by many lively discussions, both during the proceedings and over coffee, lunch and dinner. The closing discussion was led by Professor Andrew Wilson, who presented a brilliant synthesis of the conference as well as ideas for future directions.

This conference and the papers reported here have helped shed light on an important economic subject, for which there is much scope for further work. We appeal to all archaeologists to recognize the importance of collecting environmental remains, especially charcoal. Scientific studies on the quality and types of archaeological charcoal are developing fast, and so collection of all organic remains through both excavation and flotation is essential.

The study of fuel economics in the Roman or indeed in any ancient world is at a pivotal point. In time, with new research, it may be possible to synthesize regional patterns of supply and consumption for the Mediterranean. Alongside the economic view, we also need to describe in more detail the organization of the social and industrial structures that underpinned the fuel economy. This *chaîne opératoire* was something we hoped to find in this conference, but it was realized only in part, and this remains an important area for future research. Finally, quantitative modelling, in particular Bayesian modelling, could provide a useful way to examine fuel consumption patterns more accurately, taking into account the differing reliability of variables in different locations; and developing a feel for which variables were the most important in a particular locale through sensitivity analysis. This work has only just begun.

The Roman world is, of course, only one large consumer of fuel over around a millennium. Scholarship has not yet provided sufficient data to evaluate

the rest of the world's fuel consumption through time (although various pre- and proto-historic peoples have received detailed attention in case studies, notably at Gordion and Çatalhöyük). It would be useful to note how we might proceed for other geographic zones and historical time periods. The Chinese Song Dynasty (tenth to thirteen centuries) comes to mind as one culture similar to Imperial Rome in terms of population and technological advancement. In this period, the Song moved from firing kilns with wood to firing them with coal (a feat not repeated until the nineteenth century in the west with the introduction of the blast furnace). The relevance of studying ancient fuel remains appears to have become more important today as we consider the modern-world problems of pollution and climate change; and the potential of pelletized wood (at perhaps 70 per cent of the calorific value of coal)¹ as a part of our fuel future. This use of wood is in contrast to keeping the trees in the ground to facilitate carbon storage. Forest cultivation for fuel, carbon storage (and timber) then must be considered in light of land/space competition for growing food.

Finally, in closing, our second discussant, Jim Ball, former head of the FAO Forestry division, gave us an entertaining and interesting picture of some present-day forestry data relating to fuel studies, especially those in developing countries. His presentation is provided here in summarized form.

Wood fuels in the present-day context, or 'What can the past learn from the present?' Jim Ball

The studies of ancient fuel use we have heard at this conference may offer a framework for connecting ancient fuel use to that of more recent times. However, as a modern-day forester, I offer here some insights that may be of interest to those carrying out future research into ancient fuel use. As part of the FAO

(Food and Agriculture Organization) of the United Nations, the FAO Forestry Department concerns itself with forests and their growth, protection and expansion economically. The department's main role is the collection of data in the sector, as well as offering advice to countries in relation to the management of their forests including all aspects of the production and use of wood fuel, charcoal and non-wood forest products. Here I offer some information on wood fuel and charcoal production from a global perspective. Much of the information originates from FAO Forestry research, and many publications are available online.²

The global context

Putting wood fuels, of which charcoal is one, into a global context there are a number of variables:

- When wood or charcoal is used in a stove, for example, the former wastes more energy than the latter. 1 kg of air-dried wood, when burned, gives around 280 Kcal of energy (depending on the species), while 1 kg charcoal gives 420 Kcal, or over 40 per cent more (however, we must consider how much wood was used to make the charcoal – and this varies!)
- Global consumption of wood fuel for domestic use in 2011 was 1.87 billion m³ (billion being one thousand million), which is even more than industrial roundwood, which was 1.5 billion m³.
- In 2010, the value of the charcoal trade in Tanzania was \$US650 million/year.
- Presently, African Commonwealth countries use 0.6 m³ fuelwood/head/year in the home, which is five times more than industrial wood. In Sudan, we estimated 0.88 m³/head/year.
- There are few estimates of the disaggregation of firewood and charcoal, but a guesstimate from Sudan in the 1980s was that charcoal was 44 per cent of total fuelwood demand.
- The price of wood and charcoal fuel is an important component of the cost-of-living index in several African countries.

Efficiency of conversion of raw wood into charcoal

- Today's traditional earth kilns, which I presume are similar to those used by the Romans, have a conversion efficiency of 20–30 per cent, depending on the skill of the operator, and the sort of incentive they had (i.e. around 3 to 5 kg, more-or-less, of moist wood are used to make 1 kg of charcoal). Experienced operators in Sudan can achieve 30 per cent, inexperienced workers in Brazil 18–20

per cent. This conversion efficiency is calculated from standing trees, measured over-bark, through felling, cross-cutting, burning, and loading into sacks or trucks. Since much of the charcoal evidence presented in this conference suggests the use of coppice, or small woods (in a presumably sustainable way) in the Roman period, we need to use caution in making direct comparisons.

- Roman slaves may have had little incentive to be efficient, but if the charcoal burners were self-employed they had every reason to be as efficient as possible.
- Efficiency may also be improved by removing bark and by using saws (7.5 per cent loss) and not axes (15 per cent loss).

Transport and 'fines'

In Sudan charcoal is transported by truck over hundreds of kilometres, resulting in the production of a lot of 'fines,' i.e. charcoal that has broken down into dust. These are usually disposed of as waste, and in Sudan amount for up to 20 per cent of the total amount of charcoal transported. I can't imagine that transport in bulk by un-sprung Roman ox-cart produced fewer fines, although river or sea transport would have been smoother. 'Harder' woods (i.e. those often with a higher specific gravity) are more resistant to abrasion.

Landlords and charcoal

In Nigeria during the oil boom of the mid-1970s, many people came to the towns from the countryside and rented accommodation. Landlords didn't want their house walls knocked around by firewood and insisted in the terms of the rental contract that the tenant use charcoal. Was there a similar situation at the height of the Roman Empire?

Wood properties: Uganda and Sudan

Despite the fact that denser woods make better charcoal from the point of view of heat, and length of burn, the method is to clear fell all of the trees in a gap and burn them all, as opposed to a selection-based felling, which from a forester's point of view could in some situations be silviculturally preferable, since some cover would be retained over the soil. From the charcoal burner's point of view, they may have preferred to have a mixture of tree species, since some burn easier than others, in order, for example, to start the fire. These soft species would likely have been consumed entirely, and thus would be poorly represented in archaeological charcoal.

Transport of wood and charcoal

Transport in modern-day Africa is usually in sacks of charcoal for small-scale use, or else by the small parcel in the market. Only large-scale industrial users transport wood fuel in bulk. Long-distance transport adds considerably to the cost – and sometimes one wonders if more energy is used in the transport of the fuel than is carried!

Processing

Air-drying in the sun of pots, bricks or wood for charcoal burning would have presumably been an important factor in reducing wood fuel use in Mediterranean countries, as it is today in many African countries.

Modern silviculture

Human intervention in forest management to influence the frequency of a particular tree species is more prevalent today. Two examples are of interest. The first is chestnut (*Castanea sativa*) which, beginning in Roman times, was an important foodstuff and became increasingly cultivated. The second is European silver fir (*Abies alba*), which appears to have been consumed for construction in the Roman period, so much so, that numbers diminished over time. Later, regeneration

was encouraged by Benedictine monks from the seventeenth century at Vallombrosa near Florence (and possibly elsewhere) because of high demand for naval masts. Good prices were obtained for this wood.

Ironing

How did the Romans iron clothes? By banging a charcoal iron down while ironing, one's house staff could make sparks shoot out of a charcoal iron in Kenya and produce a fine speckled effect of little burns on one's shirt!

Notes

- 1 Thran et al. (2017). See also Food and Agriculture Organization (2011), and subsequent years.
- 2 www.fao.org/forestry/en/

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Fuel and Fire in the Ancient Roman World

The study of fuel economics in the Roman, or indeed in any ancient world, is at a pivotal point. New research in archaeological science, the ancient economy, the ancient environment, and especially, the increasing collection of bio-archaeological datasets, are together providing a greatly enriched resource for scholars. This volume makes a first attempt to bridge the gap between 'top-down' generalized models about Roman energy consumption with the 'case study' detail of archaeological data in the Mediterranean. The papers here are the work of scholars from a variety of disciplines: from archaeobotanists and historians to archaeologists specialising in social, technical and economic fields. A more nuanced view of the organization of the social and industrial structures that underpinned the fuel economy arises. Although focused on the Roman period, some papers extend beyond this era, providing contextual relevance from the proto-historic period onwards. Much exciting interdisciplinary work is ahead of us, if we are to situate fuel economics more clearly and prominently within our understanding of Roman economics, and indeed the ancient Mediterranean economy.

Editors:

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